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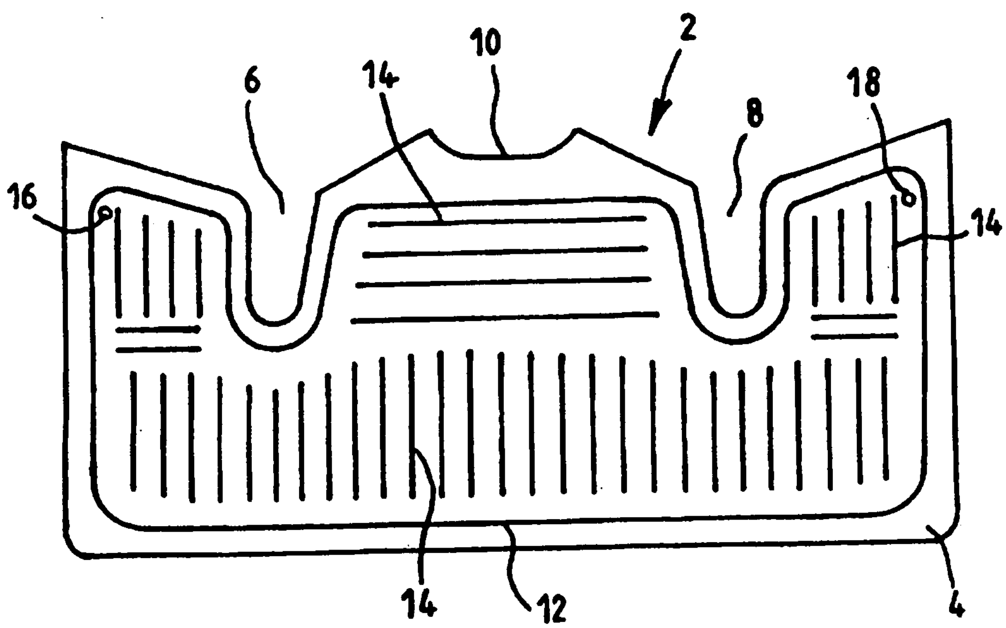

(57) Abstract

An inflatable insulation module(s) for an insulated garment comprises an inner and an outer membrane (4) sealed together to form an inflatable cavity. The membrane is formed of a water-vapour-permeable material which is breathable to allow escape of moisture from the wearer, and is air-impermeable to allow inflation of the module. The insulation value may be varied by varying the extent of inflation.

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INFLATABLE INSULATION

FIELD OF THE INVENTION

The present invention relates to an inflatable breathable (i.e. water-vapour-permeable) insulation module for a heat-transfer control article, such as an insulated garment (including suits, jackets, vests, trousers, hats and gloves) a sleep covering such as a sleeping bag or duvet, or a footwear item, such as a boot or sock. Generally speaking, such heat-transfer control articles are for personal use and are breathable so as to allow the escape of water vapour due to insensible and sensible perspiration from the person employing the article. The heat-transfer control article has heat insulation properties which may be used to prevent undue heat loss where the person is subjected to a cold environment or may provide heat-resistant insulation properties where the wearer is subject to a hot environment.

BACKGROUND

Inflatable garments are, of course, known in the art and particularly in the case of life jackets or buoyancy survival suits used for over-water air transportation. Such survival suits are inflatable both to act as buoyancy to help the wearer keep afloat following an accident at sea, and also to provide an insulating air gap which helps prevent loss of body heat from the wearer during prolonged immersion in water. Helicopter crew and passengers

travelling over water are routinely provided with inflatable survival suits. However, a problem with such inflatable suits is that the inflatable module whilst having good insulation properties is not breathable, so that perspiration from the wearer's body is unable to escape. Such moisture collects inside the suit leading to a clammy feeling which detracts from the comfort of the suit in use. US patents 4,242,769 (Rayfield) and 5,148,002 (Kuo) address the problem of lack of breathability by providing the inflatable module with a series of apertures which allow air and water vapour to pass through. In order to prevent the ingress of liquid water, these prior art proposals generally provide a face fabric formed of a liquid water-impermeable and water vapour permeable material which allows the passage of water vapour to the exterior of the garment. However, the provision of apertures in this way provides only a limited surface area through which water vapour can escape and consequently the overall garment has a low water vapour permeability. Moreover, the provision of such apertures reduces the insulation properties of the garment and unduly complicates manufacturing.

Patent specification GB2232872 describes articles having pockets filled with air. There is no mention of breathability. Specification GB964086 describes a shirt which is porous when dry but inflatable to some degree when wet. Specification EP0117303 describes an inflatable garment, which is apparently not water-vapour-permeable.

SUMMARY OF THE INVENTION

Generally speaking, the present invention resides in the use of a material which is both air impermeable (to allow inflation) and water vapour permeable (to provide breathability) for the construction of the inflatable module.

In particular, the present invention provides an inflatable breathable insulation module for a garment, footwear item, sleeping bag, duvet or other heat-transfer control article (usually for personal use); the module comprising an inner membrane and an outer membrane, the membranes being sealed together to provide an inflatable cavity (or cavities), and each membrane being formed of a water-vapour-permeable breathable material which is air-impermeable to allow inflation of the inflatable cavity.

A particular benefit of the inflatable module of the present invention is that the degree of thermal insulation imparted by the air gap within the inflated cavity can be varied to suit differing applications. The heat insulation value of the module will vary dependent on the degree of inflation of the module. It is therefore possible, by varying the degree of inflation (and thus the width of the air gap) to vary the insulation value of the garment continuously between the deflated and fully-inflated conditions. Thus, persons engaged in outdoor activities, such as sailors, golfers, hikers, policeman, labourers etc. can vary the degree of heat insulation to suit the particular climatic conditions and also in dependence on

their own work rate. A hiker may wish to have a higher insulation value when resting and to reduce the insulation value of the garment when undergoing physical activity. According to the present invention this may be achieved without removing the garment, by simply varying the degree of inflation of the inflatable module.

There may also be instances where a thermal insulation property is required to prevent the transfer of external heat to the wearer so as to keep the wearer cool. For example, a fireman tackling a fire may wish to have an improved level of thermal insulation for a relatively short period of time to reduce his body temperature rise.

The heat insulation properties of the module of the present invention may also be enhanced by known expedients such as providing a heat reflective metalised film thereon.

The inflatable breathable insulation module of the present invention will be breathable as that term is known in the art to the skilled man. Generally, the moisture vapour transmission rate of the membrane used to produce the inflatable module will be at least 500 $g/m^2/day$ and usually at least 3000 $g/m^2/day$ (based on the potassium acetate test method described herein). Typically, it will lie in the range 3000 to 20,000$g/m^2/day$. Usually, the overall breathability of the module when deflated will be in excess of 1000 $g/m^2/day$ and usually in the range 1000 to 10,000 $g/m^2/day$. The water-vapour-permeability is generally less than that for a conventional garment since two thicknesses of the membrane are present (and since the

membrane is usually thicker). The breathability will depend on the thickness of membrane used and also depends on whether the cavity is inflated or not. For example, a typical breathability figure of 2000 $g/m^2/day$ in the deflated condition may be reduced to 1200 $g/m^2/day$ when the cavity is inflated. When inflated the water-vapour-permeability is generally in the region 500 to 5000 $g/m^2/day$.

Generally, the air gap across the inflatable cavity will be in the range 0-50mm, more generally 0-30mm and typically around 20mm when inflated. Narrow air gaps have low insulation properties; whilst wide air gaps allow the formation of convection currents within the gap which detracts from the insulation properties. There is an optimum gap width inbetween these extremes which provides maximum insulation. Wide air gaps also make the module bulky and inconvenient to wear in the case of garments. Bulkiness may be less of a disadvantage in the case of sleeping bags etc.

The inflatable breathable insulation module of the present invention is formed of a membrane material which is air-impermeable as that term is known in the art and provides sufficient air impermeability for the module to remain inflated for practical periods of use. Generally, the module will require to remain inflated without substantial deflation (i.e. less than 10% by volume air loss) for a period of at least 2 hours, more generally at least 12 hours (particularly in the case of sleeping

items). The inflatable module is generally provided with inflation means which may be simply a mouthpiece (which may have an elongate extension to reach the wearer's mouth easily) in the case of oral inflation.

As regards manufacture, the module is preferably provided by sealing together the membranes at a number of positions. The module could be formed from a single membrane sheet folded in two. Generally, the membranes are sealed around their periphery to provide an overall edge seal. They are also attached together at a number of spaced positions within the cavity so as to control the degree of inflation and provide a predetermined air gap, for example at points or along lines. It is particularly convenient if the membrane material can be heat welded, since this is a technique widely used for providing inflatable items, such as air beds, and can provide a joint of sufficient strength to resist the inflation pressures generally used (which are generally less than 1 psi) and peak pressures (for example, due to impacts) which may be considerably in excess of this. Heat welding may be carried out using known apparatus and techniques (e.g. radio frequency welding, ultrasonic welding or using a heat-fusable tape).

A particular property of the membrane material is that it should have sufficient strength, toughness and elasticity to withstand the various stresses encountered during use. A primary stress is, of course, that resulting from inflation of the cavity. Other stresses arise from

flexing of the module during use and from impacts. Materials which are inextensible generally are unsatisfactory and fail at points of stress. A material having a sufficient degree of elasticity is therefore preferred since this allows the stresses to be delocalised. For those garments which are to be subjected to liquid water, for example survival suits, it is important that the properties of the membrane material and seal be maintained to a substantial extent even in the wet state. Preferably, the insulation value will be unaffected by the presence of liquid water, in contrast to known materials such as fabric piles which tend to lose their insulation properties when wet. Good puncture resistance is also an advantage.

Typically, the mechanical properties of the membrane material will be as follows:

- tensile strength (psi) 1000-10,000 (typically 3000-8000)
- elongation at break (%) 500-1000% (typically 700-800%)
- Young's modulus (psi) 1000-6000 (typically 2000-4000)
- Toughness (lb/in^3) 3000-30,000 (typically 10,000-20,000)

These properties (at least) should ideally be maintained in both wet and dry states of the membrane material (for example, plus or minus 30%).

The material employed as the membrane material is preferably a thermoplastic polyurethane or polyester. A particularly useful membrane material is that disclosed in published patent specification PCT/US94/124659 which discloses a tough elastic polyurethane suitable for use as a self-supporting film with good heat-sealing properties

and physical properties which are substantially unaffected under wet conditions. The polyurethane is the reaction product of 4,4'-diphenylmethane diisocyanate (MDI), poly(oxyethylene)glycol and 1,4-butane diol in equivalents ratio of substantially 4:1:3.

Other suitable polymers for production of the membrane are Estane X4405 (trademark) and Morthane (trademark) materials which are polyurethanes available from B.F. Goodrich, Inc., USA and Morton International, respectively.

A thermoplastic polyester material which may be used is Hytrel (trademark), such as Hytrel 8171, available from DuPont Chemicals UK.

The thickness of the membrane material is generally in the range 10-500 microns (e.g. 100-150 microns) depending on the physical properties of the material and the degree of water permeability required. Generally, for heat welding purposes, a certain minimum thickness (e.g. 50 microns depending on the material) is required, as will be appreciated by persons skilled in the art.

It is preferred that at least one of the membranes be an unsupported film since this allows dissipation of stress in use. However, a face fabric may be provided on one of the membranes, which is to provide the outer surface of the garment etc. in use. The membrane may be integrally formed (e.g. by coating) on the face fabric or may be laminated thereto, such as by heat lamination or by the use of an adhesive. Face fabrics are typically nylon, polyester or acrylic woven or knitted materials. Lycra (trademark) is

a preferred material.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS.

Embodiments of the present invention will now be described by way of example only with reference to the attached drawing labelled Figure 1 which schematically shows an inflatable breathable insulation module for use in a garment.

The inflatable breathable insulation module 2 is formed of a pair of polyurethane or polyester sheets 4 heat welded together. The sheets are in the shape of a module for fitting inside a jacket and comprise cutouts 6,8 for the arms and a cutout 10 for the neck. The sheets are heat welded together along a peripheral line 12 so as to provide an inflatable cavity. In addition, the sheets are heat welded together along a plurality of lines 14 which serve to define the air gap of the inflated module, that is to say the space in between the two membranes in the inflated condition. The arrangement of lines will also be chosen so as to accommodate flexing of the insulation module during normal useage when worn by the wearer, so as to feel as comfortable as possible. More than one cavity could be provided. If desired, the spacing between the lines 14 may be varied so as to provide for a wider air gap and greater insulation properties in certain areas of the module with smaller air gaps in other areas of the module so as to fine tune the insulation properties of the garment. However, usually the lines 14 are spaced apart by 20-40mm, typically

around 30mm. Equally, there could be areas free of insulation by cutting away an appropriate aperture in one of the two membranes.

Mouthpieces 16, 18 which may include a venting non-return valve of conventional construction are provided for oral inflation of the insulation module. The mouthpieces will occur in the upper front chest area of the wearer during use and may include elongate extensions to reach the wearer's mouth. Venting non-return valves function as a non-return valve for inflating the garment. However, the valve may be opened e.g. by squeezing the valve, to allow air to escape. Alternatively, non-return valve(s) may be provided for inflation together with one or more release valves for deflation.

In use, the inflatable breathable insulation module will usually be fitted inside a conventional jacket shell formed of an outer face fabric and an inner liner. The module may be permanently fitted or removably fitted (e.g. by zips or velcro (trademark). The module could also be in the form of a vest or waistcoat for wearing beneath a jacket.

In normal usage, the inflatable module will be in its deflated condition and will perform as a conventional breathable jacket. When enhanced thermal insulation properties are required, for example in cold weather or after physical exercise, the inflatable module may be inflated orally to provide enhanced insulation and minimise body heat loss from the wearer.

The properties of suitable water-vapour-permeable membrane materials are given in Tables A, B and C below. Material B is that disclosed in patent specification PCT/US94/124659 discussed above. The Morphane (trademark) materials are polyurethanes available from Morton International. The Estane (trademark) materials are polyurethanes available from B.F. Goodrich, Inc. MVTR is measured by the potassium acetate method disclosed herein; % elongation is elongation at break; toughness is the integral of tensile strength vs elongation.

TABLE A

Water-Vapour-Permeability

	Material B	Morthane L428-177	Morthane PB363-200	Estane 58237	Estane X4405
MVTR $g/m^2/day$	7,244 (1.5 mil film)	6,578 (1.7 mil film)	7,638 (3.0 mil film)	8,806 (0.9 mil film)	13,279 (1.5 mil film)

TABLE B

Dry Tensile Properties

	Material B	Morthane L428-177	Morthane PB363-200	Estane 58237	Estane X4405
Tensile psi strength	6680	1275	1323	3210	1696
%Elongation	836%	779%	736%	616%	778%
Young's psi Modulus	1592	2244	3397	4153	3036
Toughness lb/in^3	23,870	6,170	6,727	9,972	7,727
Film mil thickness	1.5	2.0	1.6	0.9	1.4

TABLE C

Wet Tensile Properties

	Material B	Morthane L428-177	Morthane PB363-200	Estane 58237	Estane X4405
Tensile psi strength	7051	1043	968	2931	2040
%Elongation	907%	658%	696%	690%	821%
Young's psi Modulus	1717	2032	2377	5428	4131
Toughness lb/in^3	30,400	3,789	4,559	11,450	10,560
Film mil thickness	2.0	2.9	2.1	0.9	1.4

TEST METHOD

MOISTURE VAPOUR TRANSMISSION RATE (MVTR)

(Potassium Acetate Method)

A description of a test for measurement of moisture vapour transmission rate (MVTR) i.e. water-vapour-permeability, is given below.

In the procedure, approximately 70ml of a solution consisting of 600g of potassium acetate and 185g of distilled water was placed into a 133ml. polypropylene cup, having an inside diameter of 6.5cm at its mouth. An expanded polytetrafluoroethylene (PTFE) membrane having a minimum MVTR of approximately 85,000g/m^2/24hrs. as tested by the method described in US Patent 4,862,730 to Crosby and available from W.L. Gore & Associates, Inc. of Newark, Delaware, was heat sealed to the lip of the cup to create a taut, waterproof, moisture-vapour permeable barrier

containing the solution.

A similar expanded PTFE membrane was mounted to the surface of a water bath. The water bath assembly was controlled at 23°C plus or minus 0.2°C, utilising a temperature controlled room and a water circulating bath. The sample to be tested was allowed to condition at a temperature of 23°C and a relative humidity of 50% prior to performing the test procedure. Three samples were placed so each sample to be tested was in contact with the expanded polytetrafluoroethylene membrane mounted over the surface of the water bath and in contact with the water, and was allowed to equilibrate for at least 15 minutes prior to the introduction of the cup assembly.

The cup assembly was weighed to the nearest 1/1000g and was placed in an inverted manner onto the centre of the test sample.

Water vapour transport was provided by the driving force between the water in the water bath and the saturated salt solution providing water vapour flux by diffusion in that direction. The sample was tested for 20 minutes and the cup assembly was then removed, and weighed again to within 1/1000g.

The MVTR of the sample was calculated from the weight gain of the cup assembly and was expressed in grams of water per square meter of sample surface area per 24 hours.

The invention will be further illustrated with reference to the following test results.

EXAMPLE 1

1. **AIMS**

The aim of the test was the measurement of thermal resistance Rct and evaporative resistance Ret according to International Standard ISO 11092:1993(E) (as modified as described herein) of two samples in both the flat deflated state and in the inflated state.

The samples were formed of two sheets, each comprising a polyurethane membrane as described in PCT/US94/12469 heat welded together to form an inflatable module. Sample 1 was formed from a first sheet which was a laminate of a 2 mil (50 microns) thick polyurethane membrane and a nylon Taslan (trademark) face fabric, which was heat welded to a second sheet which was a 2 mil (50 microns) thick polyurethane membrane. Sample 2 was similar to Sample 1 except that the second sheet was a 4mil (100 microns) thick polyurethane membrane.

The sample size was 380mm x 380mm, and the nominal inflated thickness was 20mm.

The samples when blown up with air require adaptation of measurement conditions which are described in paragraph 2. These introduce some deviations from ISO 11092 for measurement of evaporative resistance which are reported in paragraph 3.

2. Adaptation of measurement conditions for samples blown up with air.

The ISO 11092 test conditions required modification as follows.

Test samples were measured with the upside face covered with a thin fabric, impermeable to air penetration. In the results reported in paragraph 4, additive thermal and evaporative resistance introduced by this thin fabric (Rct = 0.002 m^2.K/W; Ret = 2.6 m^2.Pa/W) have already been subtracted from the measurement.

For evaporative resistance, the four edges of the test sample are taped so as to eliminate any possibility of lateral loss of water vapour during the test. Water vapour transfer is then guaranteed to be strictly transversal. For thermal resistance, some synthetic filling is introduced along the edges to avoid lateral thermal convection with ambient air. Thermal transfer is then strictly transversal.

3. Deviations from ISO 11092 for measurement of evaporative resistance.

For test of evaporative resistance on flat samples the internal membrane swells when in contact with moisture from the sweating plate. This introduces local air gaps under the test sample.

This air gap is usually eliminated by stretching the test sample with some lateral tension. This is inappropriate in the present case, because the external

laminate is somewhat rigid and hinders any possible extension of the internal membrane. Therefore Ret values of flat samples necessarily include this swelling of test samples in conditions of the test.

This phenomenom turns out to be more important for Sample 2 flat than for Sample 1 flat. One indication is thickness of test sample at the end of the Ret test; the difference is due to swelling of test sample:

Sample 1 flat: 1.6mm

Sample 2 flat: 3.1mm

For samples blown up with air, thickness is:

Sample 1 blown up: 20mm

Sample 2 blown up: 20mm

The dimension of the test sample (380mm x 380mm) has been adapted to cover a peripheral thermal guard for Ret measurement. The thermal guard does not perspire; therefore, the perspiring area in contact with the internal membrane is 200mm x 200mm, while the transfering area on the external face of the test sample is higher (approximately 260mm x 260mm). This does not affect the results on flat samples: for blown up samples it may introduce some deviation in the result of Ret compared with strictly uni-dimensional transfer.

4. <u>Results</u>

The results are shown in Table 1. The thermal insulation value rises in the inflated condition in both samples to about $0.25m^2.K/W$. For comparison, a conventional

fleece jacket has a value of about $0.1 m^2.K/W$. Thus, the insulation properties in the inflated condition are good.

The calculated water-vapour permeability ($g/m^2/day$) is inversely proportional to the measured evaporative resistance ($m^2.Pa/W$) and both figures are given. It should be noted that the water-vapour permeability measurement technique used for the module of the invention is a different technique to the potassium acetate test method which forms the basis for MVTR figures quoted for the membrane used to form the module. In both samples the water-vapour permeability falls to about 1200 $g/m^2/day$ in the inflated condition (air gap approximately 20mm).

Generally speaking, typical thermal insulation and water vapour permeability values for the inflatable breathable module of the present invention are 0.05 to 0.5 $m^2.K/W$ and 500 to $3000 g/m^2/day$ respectively in the inflated condition.

TABLE 1 (Thermal Insulation and Water-vapour Permeability)

	SAMPLE 1		SAMPLE 2	
	flat	**blown up**	**flat**	**blown up**
Thermal Insulation $m^2.K/W$	0.0107 (1)	0.253 (2)	0.0196 (3)	0.257 (4)
Water-vapour Resistance $m^2.Pa/W$ ($g/m^2/day$)	35.22 (5) (2227)	66.88 (6) (1183)	51.94 (7) (1519)	67.43 (8) (1174)

Individual Measurements:

(1) 0.0088 - 0.0107 - 0.0127

(2) 0.2591 - 0.2471 - 0.2523

(3) 0.0196 - 0.0197

(4) 0.256 - 0.2637 - 0.2518

(5) 36.72 - 33.72

(6) 67.27 - 66.50

(7) 53.31 - 50.57

(8) 67.07 - 67.79

EXAMPLE 2

Tests were carried out on a thermal test mannikin at Institute Textile de France to establish thermal insulation values over the chest area of the mannikin of an insulation module according to the present invention. The insulation module was constructed according to Figure 1 and formed of a two-sheet RF welded construction according to Sample 2 of Example

1 with an outer fabric covering.

The test mannikin is equipped to measure heat loss over a plurality of layers thereof, from which an insulation value was calculated. The insulation module was worn by the mannikin, and a Gore-tex (trademark) jacket of a three-layer construction was worn on top. The three-layer construction is conventional and comprises a face fabric, an expanded PTFE membrane coated with a polyurethane, and a knitted inner liner; and is water-resistant and water-vapour-permeable.

Tests carried out according to Institute Textile de France methodology showed an increase in thermal insulation of 0.15 m^2.K/W over the chest area from the deflated to the inflated state of the insulation module.

EXAMPLE 3

Field trials were carried using 60 volunteers in a variety of activities and environments including refrigerated stores, racehorse trainers, hikers, walkers, power linesmen and lorry drivers. Each volunteer wore a jacket including an inflatable module as described with reference to Figure 1. Scores were allocated by the volunteers to four aspects of performance and the results were as follows. Body heat retention scores 88/100. The benefit of a variable insulation valve scored 85/100. Chill factor

elimination scores 85/100. Release of moisture vapour scored 74/100. These scores indicated a high level of user satisfaction.

CLAIMS

1. An inflatable breathable insulation module for a heat-transfer control article;
the module comprising an inner membrane and an outer membrane, the membranes being sealed together to provide an inflatable cavity;
and each membrane being formed of a water-vapour-permeable material which is air-impermeable to allow inflation of the inflatable cavity.

2. An insulation module according to claim 1 whose insulation property is variable by varying the degree of inflation thereof.

3. An insulation module according to any preceding claim having an overall water-vapour-permeability in excess of 1000 g/m^2/day in the deflated condition.

4. An insulation module according to any preceding claim having an overall water-vapour-permeability in excess of 500 g/m^2/day in the inflated condition.

5. An insulation module according to any preceding claim which can be inflated to provide a gap between the inner and outer membranes of up to 30mm.

6. An insulation module according to any preceding claim wherein the membrane is sufficiently air-impermeable to enable the module to remain inflated for at least two hours with less than 10% by volume loss of air.

7. An insulation module according to any preceding claim which further comprises an elongate mouthpiece to allow inflation of the module.

8. An insulation module according to any preceding claim wherein the membranes are sealed together by heat welding.

9. An insulation module according to claim 8 wherein the membranes are heat-welded together along a series of lines.

10. An insulation module according to any preceding claim wherein the membranes are formed of a polyurethane.

11. An insulation module according to claim 10 wherein the polyurethane is the reaction produce of 4,4'-diphenylmethane diisocyanate, poly(oxyethylene)glycol and 1,4-butane diol in equivalents ratio of substantially 4:1:3 respectively.

12. An insulation module according to any of claims 1 to 9 wherein the membranes are formed of a polyester.

13. An insulation module according to any preceding claim wherein the membrane is heat weldable and has a thickness of 50 to 500 microns.

14. An insulation module according to any preceding claim wherein a face fabric is provided on the outer membrane.

15. A heat-transfer control article which comprises an insulation module of any preceding claim.

16. A heat-transfer control article according to claim 15 which is a garment, a footwear item, or a sleep covering.

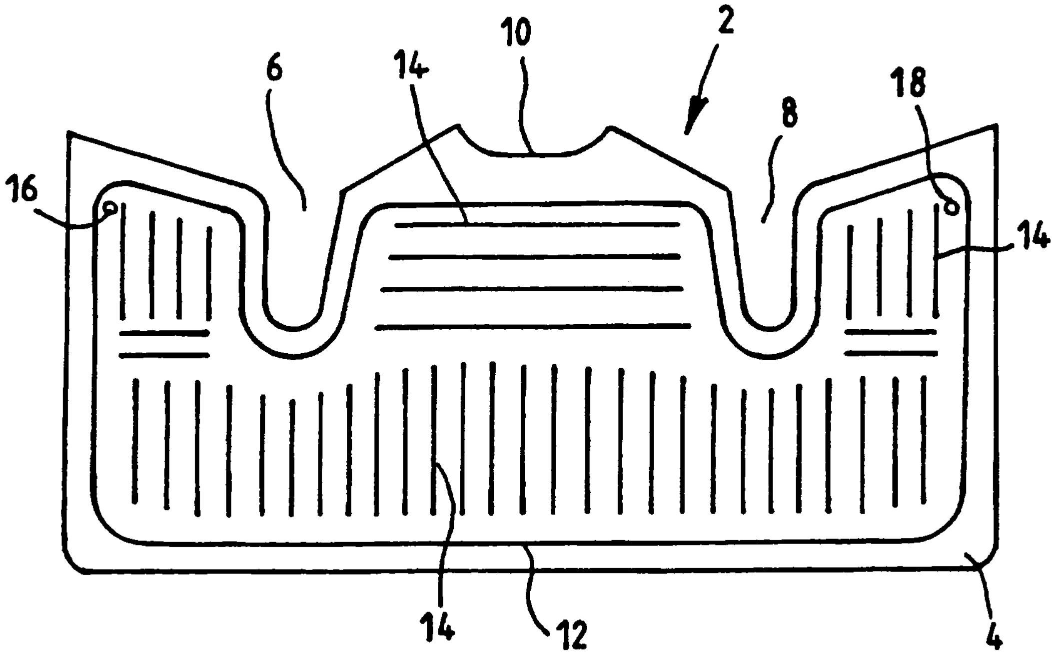

FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/02468

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A41D31/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A41D B63C B64D A47C A61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 265 314 A (SOUTH GLAMORGAN HEALTH AUTHORI) 29 September 1993 see page 3, line 1 - page 4, line 17 see page 5, line 11 - line 27 see page 6, line 13 - page 7, line 10 see page 8, line 12 - page 9, line 16; figures 1-3	1,2, 7-10,13, 15,16
Y	US 5 003 630 A (BASSICK JOHN W ET AL) 2 April 1991 see column 1, line 46 - column 2, line 12 see column 3, line 28 - line 53; figures 2,3	1-7,10, 11,13-16
Y	DE 36 05 677 A (KANEBO LTD ;KANEBO TEXTILE KK (JP)) 28 August 1986 see claims 1,2; figures 1,2,4	1-7,10, 11,13-16

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 December 1997	18/12/1997

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk	

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/02468

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 281 019 A (MULTIFABS LTD) 22 February 1995 see page 4, line 10 - page 5, line 7; claims 1,2,4; figure 2	1,10,11, 14-16
A	EP 0 117 303 A (ECKERNFOERDE TAUCHTECH) 5 September 1984 cited in the application see page 3, line 29 - line 32; figures 2,4	1,2,15, 16
A	US 4 453 271 A (DONZIS BYRON A) 12 June 1984 see column 5, line 22 - line 62 see column 11, line 26 see column 15, line 62; figures 14-16B	1,7-12, 16
A	US 3 822 425 A (SCALES J) 9 July 1974 see column 2, line 24 - line 47 see column 3, line 30 - line 42; claim 1; figure 3	1,2, 10-12,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

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